Acoustic Boundary Element Method in Workbench

November 2023

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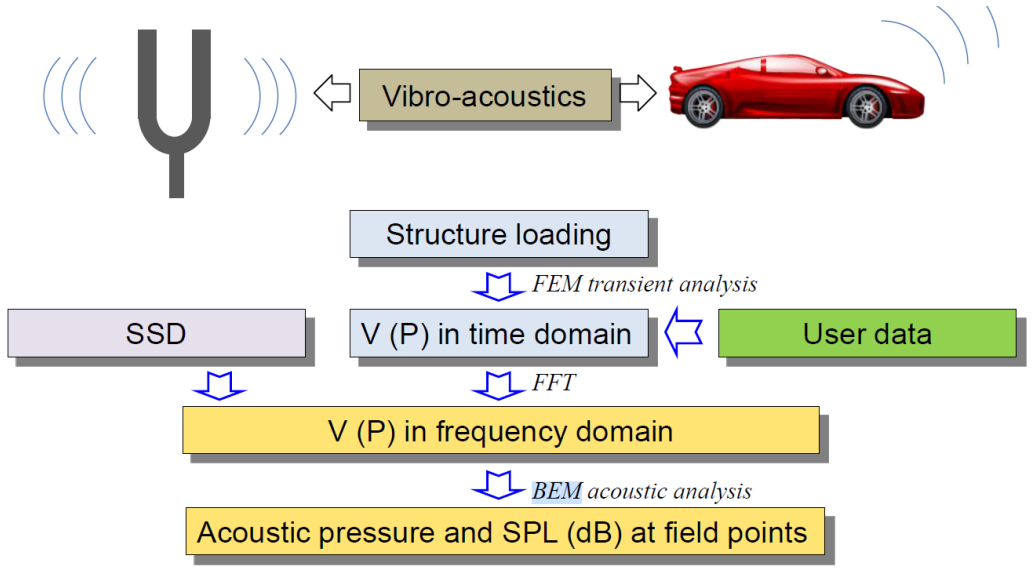
Why Acoustic Boundary Element Method (BEM)?

- Acoustic analysis require the mesh size to be less than 1/8 of the wavelength.
- Meshing the entire domain can be very costly.
- BEM only requires to mesh the boundaries.
- Therefore, this type of analysis is useful if:
  - The domain is large
  - The frequency is high
  - The frequency range is wide.



- The BEM acoustic solver is available through the LS-Dyna solver.
- We are exposing this solver in workbench.
- Only surface geometry is necessary for this type of analysis.

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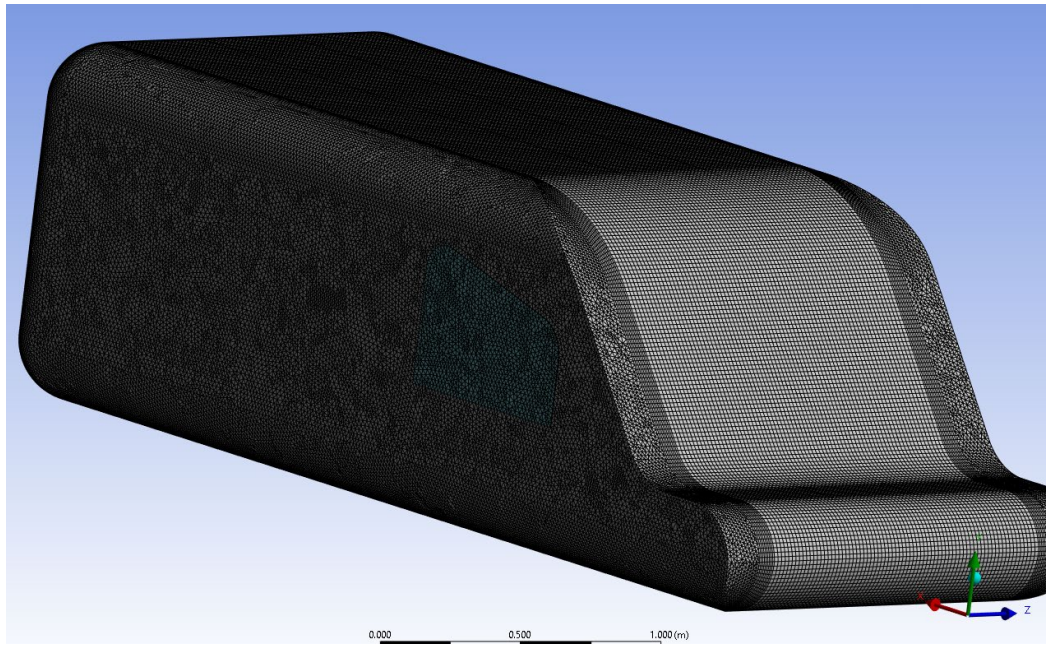
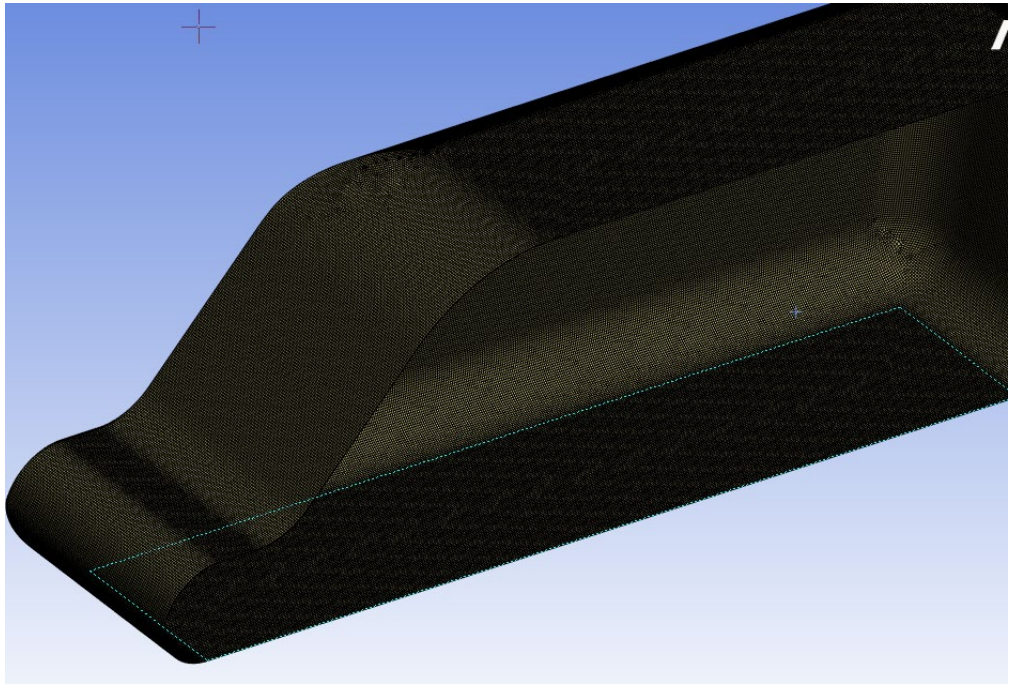
Example – Windshield Noise

- FEA requirements for one frequency only (5000 Hz):
  - 60M DOF
  - 6TB of RAM
- BEM requirements
  - 270k DOF





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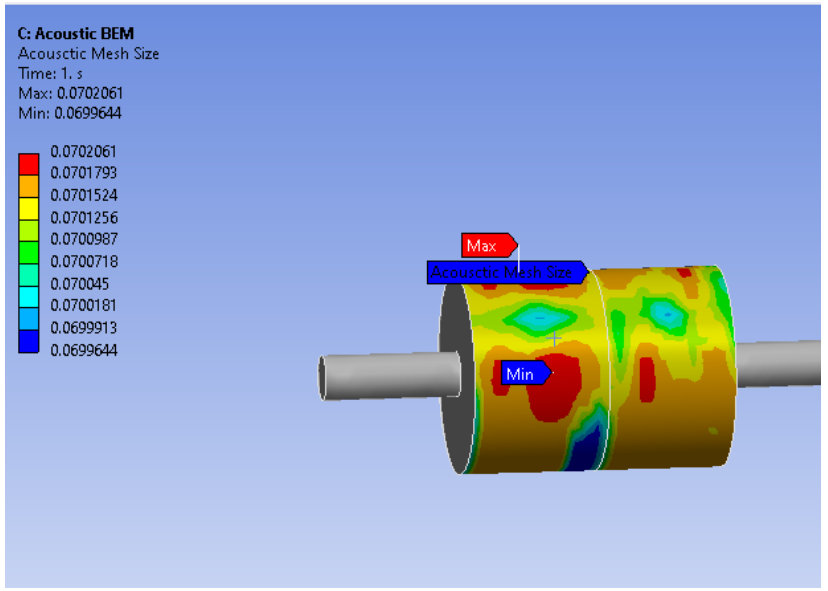
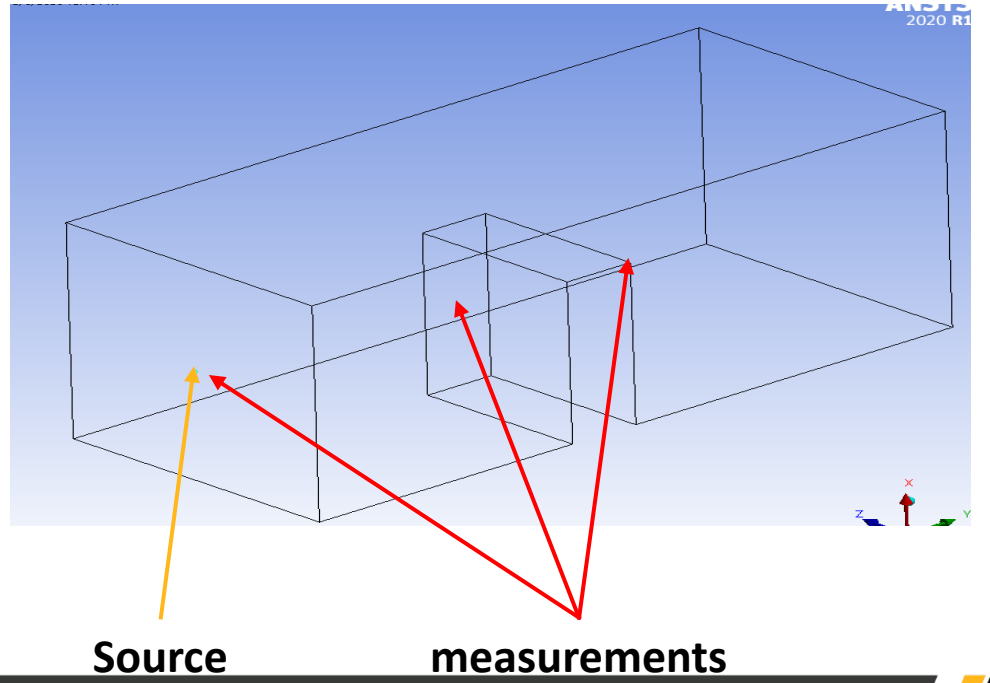
Example – Other

- Muffler
- Room acoustic (50x50x20m)
- AC unit Duct
- Container ultrasound scan
  The frequency range is 28-350Hz for 162 points.
- Mesh size: $\frac{\lambda}{8} = \frac{c}{8f} = \frac{340}{8 \times 350\,000} = 1.21.10^{-4} m = .121 mm$





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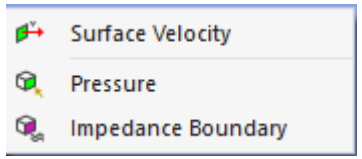
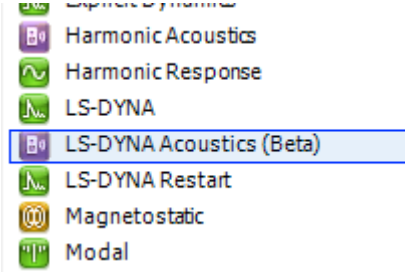
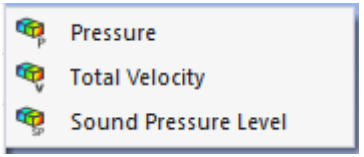
Current Status – 2023R2

- Release in workbench with product in 23R2 beta.
- Harmonic domain only
- Preprocessing:

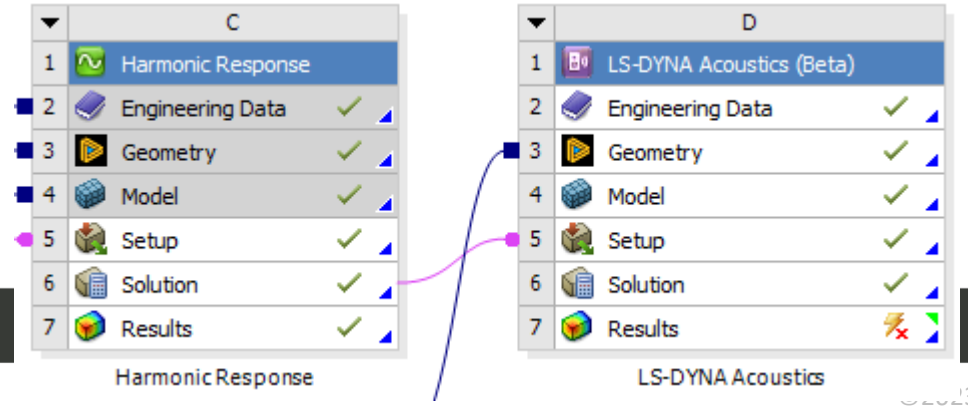


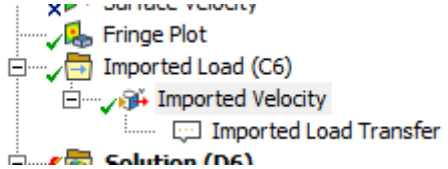


- Post processing (only on boundary surfaces):



- Link with harmonic acoustics (mapped velocities)





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Current Status – 2023R2

- Analysis Settings (*FREQUENCY_DOMAIN_ACOUSTIC_BEM). Available options are:

Details of "Analysis Settings"

General	
Range Minimum	10 Hz
Range Maximum	3000 Hz
Solution Intervals	300
Fluid	
Fluid Density	1.21E-09 kg/mm³
Sound speed of the fluid	343000 mm/s
Reference pressure	2E-11 MPa
Solver	
Method used in acoustic analysis	collocation BEM
Maximum number of iterations	1000
Tolerance	1E-06
Number of Domain Decompositions	8
Memory Allocation (Mo)	100
Number of CPUS	6
Analysis Data Management	

- Acoustic mesh size: calculate element length/ wavelength

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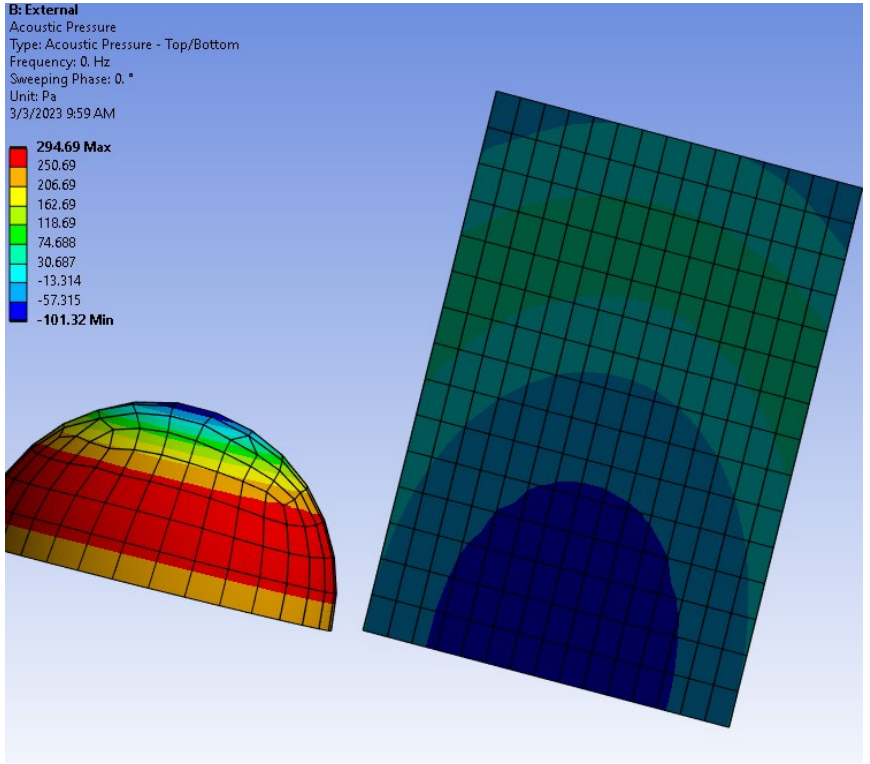
2024R1

- Beta flag removed
- Post processing of contour remote surface, fringe plot.
- Post processing on remote points 2D graph.



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Roadmap 2024R2,…..

- Multi RPM
- Map loads from other systems:
  - Fluent (*.cgns)
  - External data
  - Maxwell
- Additional boundary conditions (symmetry,…)
- Bridge to Virtual Reality Sound
- Shock boundary element method, transient analysis
- Suggestions….

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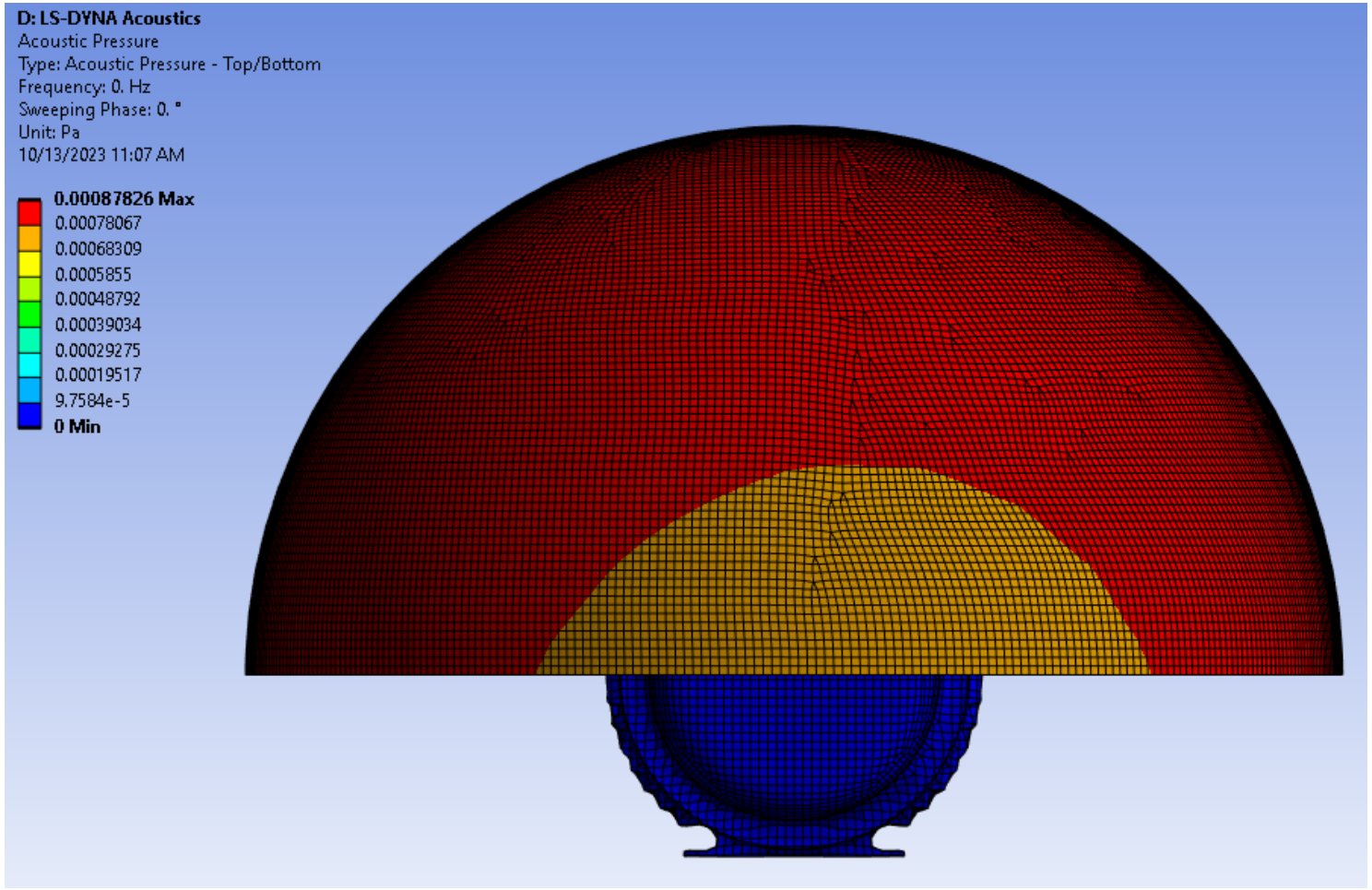
Workbench Demo



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